

John Stoddart, Junr.

Philosophical Enquiry
INTO THE
NATURE
OF
GRAVITY.

—Circumfuso pendebat in aere tellus

Ponderibus librata suis. —

OVID.



L O N D O N:

Printed for A. BETTESWORTH, at the Red
Lyon in Pater-noster-Row. 1726.



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TO THE
*SOPHS
OF THE
University of CAMBRIDGE.

GENTLEMEN,



INCE the Question I
have here consider'd, and,
with a great deal of Li-
berty, reasoned upon, (a
Presumption I confess, I ought not to

* These are the Students which are in their Fourth Year, and study nothing but Philosophy. They are commonly called Sophs, but their proper Name is Sophister.

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have been guilty of) I think it my Duty rather to ask your Pardon for this forward Attempt, and ready Determination, than to desire you to patronize what I have in the following Lines advanc'd. But if I declare that I have no further View, than to let you understand what I have thought of the Matter, and to desire your Consideration, rather than Approbation; I hope you will easily excuse the Freedom I take in dedicating my Thoughts unto you.

Having formerly been a Member of your University, and during my Stay there, in time arriv'd at (tho' unworthy of the Name) the Dignity of a Soph; I became at least sensible of the sound Judgment and quick Apprehension of that learned Body,
in

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in giving a true Determination of Questions of this, or the like Nature. I have with a great deal of Pleasure, heard all kind of Philosophical Questions truly and judiciously discuss'd in your Schools; the Reasons for them fairly maintain'd, and the Objections against them, ingeniously drawn up in a syllogistical Way; and when the Argument on both Sides had been thoroughly disputed, a final and candid Determination was always given by your worthy and learned Moderators.

I believe I may, without Envy or Prejudice, pronounce Cambridge the Fountain and Spring of Philosophy; where not only the false and erroneous Opinions of the antient Philosophers have been plainly confuted, and quite exploded;

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exploded ; but those new Hypotheses, or rather true Systems of Philosophy, which are now universally receiv'd, owe their Original and Increase to that famous University. I shall not here enumerate those learned and ingenious Persons, to whose Penetration and Sagacity, the Improvement of our Modern Philosophy is owing ; since their Fame is so well establish'd by their Works, as to make them no Strangers to foreign Countries.

I shall only beg, judicious Sirs, before you peruse the following Lines, that you would (as Philosophers ought to do) lay aside all Prejudice and Predetermination, and give a free Judgment of the whole, as your Reason it self directs you ; and then I hope you will think more favourably

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bly of the Author, who freely submits himself to your discerning Judgment, and takes this Opportunity of declaring himself,

Gentlemen,

Your most Obedient, and

Most Humble Servant,

ΦΙΛΟ·ΣΟΦΟΣ.

ДЕДИАЦИОН
-ІІІ (із ф. 101а) зі змін
-ами, змінами та зі змін
-ами (Однаково відмінно)

Дедиціон

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A

Philosophical Enquiry

INTO THE

Nature of Gravity.



BEFORE I enter upon a Philosophical Enquiry into the Nature of *Gravity*, it will be proper to know what we mean by *Gravity*; in what Sense it is taken; and how it exists in Nature: And that we may not be mistaken in our Notion of it, I shall define it according to the best and most approved Philosophers.

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DEFINITION.

Gravity is a Quality or Property of Matter, by which all Bodies have a Tendency or Propension towards one another ; and that this Quality or Property is actually in all Celestial Bodies throughout the whole solar System, and that it acts by the same constant and regular Law, *viz.* That as Bodies recede from one another, between which there is a mutual Tendency, the Force or Power of this Property decreases as the Squares of the Distances increase, and *vice versa* ; and that the *Gravity* of Bodies descending from the Surface towards the Center, decreases in a simple *Ratio* of the Distance from the Center ; and that this Quality or Property

perty is in all Bodies, which have either been observ'd or experienc'd, and is proportional to the Quantity of Matter contained in them.

First, I shall consider *Gravity*, as being proportional to the Quantity of Matter in Bodies.

This is a *Postulatum*, which I think I need not beg of those who maintain the contrary Opinion, because Experience it self has sufficiently confirm'd it. That *Gravity* is no occult Quality, is plain, because it has its real Existence in Nature; and that it is always proportional to the Quantity of Matter in Bodies, is equally evident from Experience. It remains, therefore, that we examine How it is proportional to the Quan-

tity of Matter ; and whether or no, it may not exist in any other Proportion.

In order to this, let us suppose a Globe of Gold, (which is the most solid Body we know of) its *Gravity* is found by Experience, to be proportional to the Quantity of Matter contained in it : Suppose its Magnitude to continue the same, but its Matter to be but half as much, then its *Gravity* will be but half as much. Suppose its Magnitude still to continue the same, and its Matter to be but half of what it was before, then its *Gravity* will be 3 times less than it was at first : By a third Supposition (its Magnitude always continuing the same) its *Gravity* will then be 7 times less than it

it was at first ; by a fourth, its *Gravity* will be 15 times less than at first ; by a fifth, 31 times less than at first ; by a sixth, 63 ; by a seventh, 127 ; by an eighth, 255 ; by a ninth, 511 ; by a tenth Supposition, 1023 times less than at first. And so by lessening its Matter, we diminish its *Gravity* in the same Proportion ; and this we may continue to do, 'till the Globe of Gold becomes specifically lighter than an equal Bulk of Air ; its *Gravity* will still be proportional to its Quantity of Matter. Suppose lastly, That the Matter contain'd in this Globe, be rarefied to such a Degree, that it becomes an infinitely small Quantity ; its *Gravity* will then be infinitely small. In short, be this Globe rarefied to ever so great a Degree, its *Gravity*

Gravity will always be proportional to the Quantity of Matter contained in it. So that it is impossible for any one to conceive the *Gravity* of this Globe to cease to be, or to become nothing, (tho' it may become insensible) until the Matter of this Globe it self be perfectly annihilated.

Again, let us suppose the specifick *Gravity* of this Globe of Gold to continue the same, but its Magnitude to be diminish'd after the same Manner, as its *Gravity* was in the former Supposition, and we shall find that the Conclusion will be the very same. For when its Magnitude is diminish'd so as to become infinitely small, its *Gravity* will be so too; but yet (as in the former Case) it will

will not cease to be something, 'till this infinitely small *Particule* becomes nothing, that is, 'till it be perfectly annihilated.

I shall in the second Place consider, Whether or no, *Gravity* may not exist in any other Proportion, than that which increases and decreases, as Matter it self. And in order to do this, it will be necessary to consider some System of Bodies gravitating towards one another, and herein, I shall make choice of *Jupiter* and his Satellites. I shall only here by the Way, take Notice of the Observation, Astronomers make concerning the Motion of this System of Bodies, *viz.* That their *Gravity* towards the Sun, is proportional to the Quantity of Matter contain'd in them;

them ; and they draw this Conclusion from the very regular Motion of his Satellites.

From this Observation therefore, agreed on by all Astronomers, I shall prove, that their *Gravity* to the Sun, is proportional to the Quantity of Matter contained in them.

First then, If any of these Satellites was attracted to the Sun, in any *Ratio* greater than the rest in Proportion to their Quantity of Matter ; the regular Motion of the Satellites from this unequal Attraction, would be very much disturb'd. Again, If any Satellite was heavier or gravitated more to the Sun (at equal Distances from the Sun) in Proportion to its Quantity of Matter, than *Jupiter* in

in Proportion to his Quantity of Matter, in any given *Ratio*, suppose as d to e , then the Distance between the Center of the Sun, and the Center of the Satellite's Orbit, would be always greater than the Distance between the Center of the Sun, and the Center of *Jupiter*, in a sub-duplicate *Ratio* very nearly ; as Sir *Isaac* Himself has demonstrated. Again, If the Satellite in Proportion to its Quantity of Matter, gravitated less to the Sun than *Jupiter*, suppose in the same *Ratio* of d to e , then the Distance of the Center of the Orbit of the Satellite from the Sun, would be always less than the Distance of the Center of *Jupiter* from the Sun in the same subduplicate *Ratio*. Therefore if at equal Distances from the Sun, the accelerated *Grav-*

vity of any Satellite to the Sun, be greater or less than the accelerated Gravity of Jupiter to the Sun, by only the 1000 Part of its whole Gravity; the Distance of the Center of its Orbit from the Sun, would be greater or less than the Distance of the Center of Jupiter from the Sun, by one two thousandth Part of its whole Distance; that is, by one fifth Part of the Distance of the outermost Satellite from the Center of Jupiter; and this would make the Excentricity of its Orbit very sensible. But the Orbits of the Satellites are concentrick to Jupiter; therefore, the accelerated Force or Gravity of them, and Jupiter, to the Sun, must be equal. And by the same Argument, the Gravity of Saturn and his Satellites, Jupiter and his Satellites, the Earth

Earth and her Satellite to the Sun (at equal Distances from the Sun) is proportional to the Quantity of Matter contain'd in each of 'em. And in short, their *Gravity* to the Sun, is either none at all, or it is proportional to the Quantity of Matter contain'd in them : But that they have *Gravity*, is prov'd from *Cor. 1.* and *3 Prop. 5 Lib. 3 Princip.* This the incomparable Sir *Isaac Newton* has demonstrated.

To conclude therefore, this Proposition, I shall beg leave to quote the ingenious Mr. *Derham*. For should, saith He, the Power of *Gravity* (for Instance) have been so constituted, as to decrease in the Proportion of the Cubes (instead of the Squares) of the Distances recipro-

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cally; altho' it might be possible to adjust a Velocity, and I may add, a Direction too, so as to make Bodies describe perfect Circles, yet the least Excess or Defect of Velocity, or the least Obliquity of Direction, would make them describe spiral Curves, either ascending *in Infinitum*, or else descending to the Center. And supposing the Orbs (in which those Bodies move, and which are suppos'd, as I said, to be made in Proportion of the Cubes) to be perfectly circular, the least adventitious Force, even but of an Atom, abating or increasing the Velocity, or changing the Direction, would bring on the aforesaid Inconveniences.

In the next Place, I shall endeavour to prove, that *Gravity* always acts

acts by the same constant and regular Law, *viz.* That as Bodies recede from one another, between which there is a mutual Tendency, the Force or Power of this Property, decreases as the Squares of the Distances increase, and *vice versa*; and that the *Gravity* of Bodies descending from the Surface towards the Center, decreases in a simple *Ratio* of the Distance from the Center very nearly.

As to the latter Part of this Proposition, *viz.* That the *Gravity* of Bodies descending from the Surface towards the Center, decreases in a simple *Ratio* of the Distance from the Center, would be exactly true in a Globe of uniform Density; therefore, the more unequal the Density of any Globe is, the more it varies from

from this Proportion. As to the Demonstration of this Part of the Proposition, I shall refer to the 73 Prop. Lib. 1. *Princip.* because it is not to be done without a Scheme, which the Reader may consult at his Leisure.

To proceed therefore to the former Part of the Proposition. From Observations on terrestrial Bodies, that they all gravitate towards the Earth, and that their *Gravity*, at equal Distances from the Earth, is proportional to the Quantity of Matter contain'd in them, and as the Square of the Distance from the Center of the Earth reciprocally ; we may very safely conclude, that those Bodies which are at a greater Distance from us, and of the same Nature with

with our Earth, are endow'd with the same Properties, and act according to the same Laws, *viz.* That their *Gravity* is proportional to the Quantity of Matter contained in them, and as the Squares of their Distances from their central Body reciprocally. This the fore-cited admirable Person has demonstrated to be true, in respect to our solar System ; and from Reasonings which have in 'em the greatest Degree of Probability, He shews, that the same will hold good in respect to the fix'd Stars also, which are suppos'd to be Suns to other Systems, analogous to this of ours.

Since therefore it evidently appears, that all Bodies which have ever been observ'd or experienc'd,
are

are found to be endow'd with this Property of *Gravity*, and that it is of the same Nature, and observes the same Laws in them all; why should we scruple to affirm it to be in those Bodies also, which exist, but are at so great a Distance, that they escape our Observation? Can we suppose any System of Bodies to exist in any Part of the vast *Expansum*, which the Hand of Providence has not placed there? Can we suppose them to be governed by any Laws, but such as are simple and natural? To neglect that Regularity and Order which is always observ'd in Systems of Bodies? Can we suppose the Bodies of any System to be governed by Laws different from one another? To be moved in Directions contrary to each other? To strike

strike and impel one another ? To disturb and destroy each other's Motion ? In short, Can we suppose any System of Bodies to exist in any Part of immense Space, which observes no certain and regular Laws, wherein all that Harmony and Symmetry, which is the Glory of other Systems, is neglected, unobserv'd, and forgotten ? These and worse Consequences would follow from the Supposition of a System of Bodies to exist, depriv'd of that Order and Harmony which is visible in ours.

But since there are a Sect of Men in the World, which call themselves Philosophers, who have got stronger Imaginations, than ever the *Chaldean* Shepherds could boast of ; for they only could fancy, that those Stars

which make up the Constellations of the Heavens, were ranged in such an Order, that they represented to 'em, the Likenesses of a Ram, a Bull, Twins, &c. but these Men can imagine Matter to exist, depriv'd of that most useful and universal Property *Gravity*, a far more difficult Thing to conceive: But since there there are, I say, such Philosophers as these in the World, who, notwithstanding they allow *Gravity* to be Universal, that is, in all Bodies whatever; yet they deny, that it is essential to Matter, or so connected and join'd to its Nature, that we cannot suppose Matter to exist without it: It will be proper therefore, to reason a little with 'em in their own Way, and to see how our Idea agrees with

with theirs, of Matter existing without *Gravity*.

Let us therefore, suppose some Part of our Solar System, by some Means or other, all of a sudden to lose its *Gravity*, and then see what will be the Consequence of it.

We will first, then, suppose the Sun to be annihilated, (and then we are all sure that its *Gravity*, or that Power, by which it attracts the Planets, is gone) what would be the Consequence, if this Supposition were true? Or what Alteration would be made amongst the Planets, which now make their periodical Revolutions constant and regular round the Sun? The Consequence would be this, *viz.* That all the Planets,

when quite freed and disintangled from the Action of the Sun, would move off in tangental Lines, *ad infinitum*. This the Mathematicians have demonstrated, and we may rightly enough conclude it, from the Moon describing a greater Orbit, when the Attraction of her central Body, the Earth, is lessened by the Action of the Sun ; as it happens, when the Earth is in its Perihelion ; for then the Earth attracting the Moon, less than at other times, she flies off, and will fly off, so long as the Earth gives her Band ; that is, she will recede so far from the Earth, until her *Gravity* becomes proportional to the Square of her Distance from the Center of the Earth reciprocally ; and then she will be got to the Length of her Tether, and kept in again, drawn

drawn from her rectilineal Course,
and govern'd by the same Laws she
was before.

The Moon endeavours to break off from the Earth every Moment, but cannot, because of the Earth's attractive Force, which keeps her in her Orbit; but if by some unlucky Accident, the String of Attraction should be broken, she would then move off in a tangential Course, *ad infinitum*; and bid adieu for ever to the Earth, which had so many Ages prevented her from taking her Pleasure in the vast and boundless Space of Immensity.

The Case would be the very same, were the Sun to lose its attractive Power, by which he acts upon the primary

primary Planets that move round him, to keep them in their Orbs.

In the next Place, let us consider what would be the Consequence, if all the Planets in our Solar System, both primary and secondary, were at one Instant depriv'd of *Gravity*. This is a Supposition, I must own, which stretches the Imagination to think what would become of 'em, what sort of Bodies they would be, and in what State they would then continue. But however, as it is necessary to make it, so it is also to consider the Consequences of it,

First then, They must either all center to the Sun, as if frightened by the Hand that made them, which is now supposed to have taken from them

them the noblest Part of their Nature; or else they must traverse thro' the pathless Space of Immensity, to hide themselves from the Face of an angry Creator; Or lastly, They must stand aghast at such a sudden Shock of Nature.

Let us therefore consider the first Case, whether or no, the Planets, when depriv'd of *Gravity*, would center to the Sun.

That they will not do this, is manifest from hence, because this would be the Consequence, were they all of a sudden stopt in their Orbs, whereby their projectile Force would be quite destroy'd; for they would then, by their own *Gravity*, descend to the Sun, and center about him.

If

If their *Gravity* therefore be the Cause of their Descent to the Sun, when depriv'd of all their Velocity ; 'tis evident that will not be the Case with 'em, when *Gravity* is taken away ; for without the Cause, the Effect will not be produced ; therefore, when the Cause is taken away, the Effect will be so too ; and consequently they will not descend to the Sun.

I shall in the next Place consider, Whether or no the Planets, when depriv'd of their *Gravity*, will move off in Tangents, *ad infinitum*.

But before I touch upon this, 'twill be necessary to premise something preparative to a just Enquiry into the Matter. It will be easily granted

granted me, I suppose, That the same Cause cannot produce two different Effects in the same Circumstances ; or, that the same Effect cannot be produced by two different Causes, the Circumstances remaining the same. It may perhaps be possible for the same Cause to produce two different Effects, but then the Circumstances must certainly be chang'd and alter'd, as the Effect it self becomes different.

But to return to the Thing to be considered, and that was, Whether or no the Planets would move off in Tangents, *ad infinitum*, if they were deprived of Gravity ?

It has been proved above, that was the Sun to cease acting upon the
E Planets,

Planets, by which he retains them in their Orbs; or to be annihilated, which is the same Thing in respect to the Case in Hand; that then the Planets by their *Gravity* and Velocity, would fly off in tangential Directions, *ad infinitum*. If therefore this would be the Case with the Planets when they have their *Gravity*; how can we suppose it to be the same with them when they are depriv'd of it? Is not the Circumstances here manifestly chang'd and alter'd? Is there not a great deal of Difference between Matter that has *Gravity*, and that which is suppos'd to have none? Must there not be a proportional Difference in the Effect, whether the Circumstances be changed in the Cause effecting, or the Thing effected? If this be allowed, which I think

I think cannot well be denied, then it is past all doubt (to any unprejudiced Reasoner) that the Planets, when depriv'd of their *Gravity*, will not move off in Tangents *ad infinitum.*

¶ Again, There have been several ingenious Men in the World, who have taken Motion to be a necessary Consequence of *Gravity*; if so, then some might say, there never could be any such a Thing as absolute Rest in the World; but I suppose they only meant of the Action or Exercise of *Gravity*, in respect to some System of Bodies gravitating towards one another, and then it must be true. For I affirm, that where-ever there is Motion, there must be *Gravity*, but that there may be *Gravity* where

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there is no Motion ; for I can conceive a Body to exist in the World, all others being annihilated, whose Parts shall be absolutely at Rest in respect to one another, and the Parts of Space. But as for this latter Part of the Proposition, since it concerns not the Matter in Hand, I shall omit it ; for it is sufficient for me, that Motion is a necessary Consequence of the Action of *Gravity*, and a Capacity of being moved, of *Gravity* it self.

Since this is the Case, I shall now turn my self to my Philosophers, and ask 'em, How it is that they make the Planets move off in Tangents *ad infinitum*, when they have taken away their *Gravity*, which is a necessary Consequence of Motion, as Motion

Motion is of the Action of it? Or, What Cause they have attributed that Motion to in their own Ideas? Perhaps they may say this Motion is owing to the *Vis inertiae* of Bodies. I own, so long as Matter is endow'd with *Gravity*, it naturally perseveres in its State of Rest, or Motion, by what we call its *Vis inertiae*; or the Reluctancy with which it resists Bodies which endeavour to change its State, and is always proportionable to the Quantity of Matter in Bodies; *Gravity* also increases and decreases in the same Proportion: Therefore, whatever is the Cause of *Gravity*, the same is also the Cause of the *Vis inertiae*; when the Cause therefore of either is taken away, they must both consequently cease to be. But if they say, that Bodies will persevere in

in their State of Rest, or Motion, when their *Gravity* is taken away, by the same *Vis inertiae* which they do when they have *Gravity*, (for there can be none other) is so palpably false, that it is hardly worth while to confute it. For, if Sir Isaac Newton has rightly distinguish'd the *Vis inertiae* from *Gravity*, by *Resistentia* and *Impetus*; then we shall find, that this *Vis inertiae* never exerts itself, but at the Concourse, or Collision of Bodies. The *Resistentia* he has attributed to Bodies at Rest; *Impetus*, to Bodies in Motion. *Resistentia* is the Force by which any Body at Rest resists another in Motion, which endeavours to change its State of Rest, and is always proportional to the Quantity of Matter only. *Impetus* is the Force by which any Body

Body in Motion, endeavours to change its State of another, either in Motion or Rest, by impelling it, and is always proportional to the Quantity of Matter multiplyed into its Velocity. So that we find the *Resistentia* of a Body is always equal to its *Gravity*, or the Quantity of Matter contained in it. The *Impetus* of a Body is always equal to the Moment arising from its *Gravity*, or Quantity of Matter, being multiplyed into its Velocity: So that in short, What is this *Vis inertiae* at last? It is only *Gravity* acting in some certain Circumstances, either in changing the State of Bodies by Impulse; or resisting the impelling Force of Bodies, by which they endeavour to change the State of others at Rest.

According

According to Sir Isaac Newton, the *Vis inertiae* is a passive Principle, by which Bodies persist in their Motion or Rest, receive Motion in Proportion to the Force impressing it, and resist as much as they are resisted. By this Principle alone there never could have been any Motion in the World: Some other Principle was necessary for putting Bodies into Motion; and now they are in Motion, some other Principle is necessary for conserving the Motion. Seeing therefore, the Variety of Motion which we find in the World is always decreasing, there is a Necessity of conserving and recruiting it by active Principles, such as are the Cause of Gravity, by which Planets and Comets keep their Motions in their Orbs, and Bodies acquire

acquire great Motion in falling ; and the Cause of Fermentation by which the Heart and Blood of Animals are kept in perpetual Motion and Heat ; The inward Parts of the Earth are constantly warm'd, and in some Places grow very hot ; Bodies burn and shine, Mountains take fire, the Caverns of the Earth are blown up, and the Sun continues violently hot and lucid, and warms all Things by his Light. For we meet with very little Motion in the World, besides what is owing to these active Principles : And if it were not for these Principles, the Bodies of the Earth, Planets, Comets, Sun, and all Things in them, would grow cold and freeze, and become inactive Masses ; and all Putrefaction, Generation, Vegetation, and Life, would

cease, and the Planets and Comets would not continue to move in their Orbs.

I come now, in the last Place, to consider, What would be the State and Condition of the Heavenly Bodies in our System, supposing them to be depriv'd of that universal Property *Gravity*.

First, I have shewn, that they cannot center to the Sun ; and also, that they cannot move off in Tangents, *ad infinitum* ; It follows then, *thirdly* and *lastly*, that they must remain fix'd and immoveable, ineffective and motionless.

Let us now for a while, suppose our selves to be placed in the Sun,

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and that our Eyes were strong enough to carry Sight throughout the whole solar System ; What a surprizing Alteration should we then see among all the Planets ? To see those noble Bodies, which for so many Ages had revolved about the Sun, and by their constant and regular Motion, had all along proclaim'd the Existence of their Author ; and by their Magnitude and Greatness, his infinite Power in creating them ; and by their due Distances from the Sun, in a most exact Proportion, his infinite Wisdom in placing them ; To look upon them, I say, and see them all fix'd and immoveable, lifeless and dead, as if Nature had all of a sudden, in one Moment, sicken'd and expir'd ; how dreadful and shocking a Thought would it be, to think that those Bo-

dies, which for so vast a Number of Years, had sung the Praises of their Creator, should now be silent of Him ? How terrible and astonishing would it be to the Inhabitants of the Planets, that some of them should live in continual Day, and never more to have the silent Night, in which they used to rest their wearied Bodies ; and that others should be confin'd to eternal Darkness, depriv'd for ever of the glorious Light of the Sun ? That the Distinction of Day and Night should then be for ever lost, and Morning and Evening never to return again ; and nothing of them to remain but their Names, to put them in Mind of that great Happiness they are now depriv'd of, which once they, thoughtless of, enjoy'd ?

I have

I have now considered the three Cases I laid down, one of which must necessarily be the Consequence, if the Planets were depriv'd of their *Gravity*, viz. Whether they would center to the Sun ; or move off in Tangents *ad infinitum* ; or, *lastly*, remain fix'd and immoveable. But lest what I have laid down, should not seem conclusive enough, I will reason a little upon the whole.

If therefore we can suppose no Bodies in the material World existing without this Property *Gravity*, then it may be said to be an universal One, and if it be universal, why may it not be number'd among the primary Qualities of Matter ? But perhaps some may say, that it was possible at first

first for Matter to have existed without it ; that is, that it was in the Power of God to have created Matter without this Property. But if they mean that *Gravity* is not a primary Quality of Matter in this Sense ; it will appear that Impenetrability and Mobility are not, for it was equally in the Power of God to have created Matter without these Properties also ; therefore, I presume, that they do not mean that *Gravity* is not essential to Matter in this Sense. Let us therefore see in what Sense they mean that *Gravity* is not essential to Matter. It must be in this, *viz.* That Matter may be suppos'd to exist with those primary Qualities of Extension, Impenetrability, and Mobility depriv'd of *Gravity*. If this is what they mean, let us now consider what Defects

fects there would be in the material World for want of this Property.

There is one very great Use of *Gravity* which is taken Notice of by most Astronomers, and that is, The Parts of Matter which constitute the Planets, by their Rotation round their Axes, would fly off in right Lines, *ad infinitum*; if their *Gravity* was not strong enough to prevail over the *Vis centrifuga*. But whether they mean if the Parts which compose the Planets, were intirely void of *Gravity*; or, that their *Gravity* was not powerful enough to overcome the *Vis centrifuga*, is now to be inquir'd into; for it is certain the Effect will not be the same in both Cases. I will only consider the one, and leave the other to be guess'd at,

at. I will suppose then, that the *Gravity* of the Parts of Matter which make up the Planets, was not strong enough to overcome the *Vis centrifuga* (and this is possible to be, by supposing them to revolve round their Axes with an infinite Degree of Swift-ness) if so, then the Consequence would be this, *viz.* That the Planets by such an incredible Velocity round their Axes, would be shook and shatter'd in Pieces, and would disperse themselves throughout the Ætherial Space like Dust in a Whirlwind. Since therefore, this would be the Case, were the *Vis centrifuga* too powerful for *Gravity*, I presume the Effect would not be the same, were *Gravity* suppos'd to be away.

There

There is another Defect, arising from the Absence of *Gravity*, and which seems to be the most material one, from whence ten thousand other Inconveniences would follow) and that is, that there would be no Motion in the World, without the continual Assistance of the Almighty's Hand. The Planets would then no longer revolve in their central Orb of Light, in that comely Order, and beautiful Harmony, whereby they are continually shedding their benign Influences on one another.

But if it appear, as is highly probable, that God at first created Matter with this Property, which, as a secondary Cause, should continue and preserve Motion in the World;

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should make Bodies gravitate towards one another, and keep the Planets and Comets revolving in their Orbs ; and preserve that Harmony which is visible among them, to the Glory of their Creator, and the Good of Mankind : Then I think it will evidently follow, that if *Gravity* were away, and consequently this secondary Cause cease to be, that then, to preserve Motion, and the Advantages that arise from it, there would be need of no less than the first Cause and Mover of all Things.

But again, Had Matter at first been created without *Gravity* (or with *Gravity*, had it been absolutely at Rest, and then it must have been amass'd together) there would never have been any Motion in the World, without

without some free Agent, which had a Principle of Action, had put it in Motion. For, as a learned Author argues, if Matter be suppos'd to exist necessarily ; then in that necessary Existence, there is either included the Power of Gravitation, or not ; if not, then in a World merely Material, and in which no intelligent Being presides, there never could have been any Motion ; because Motion, as he has demonstrated, and is granted in the Question, is not necessary of it self ; therefore it follows, that it must have some Cause. Let us therefore inquire, what Cause it can properly have.

First then, it must either have some secondary Cause, by which it is put in Motion and continu'd, such

a one as *Gravity* is, or else it must have some intelligent Being continually attending on it, to give it Motion, and preserve it. Now in the next Place, it remains to be inquir'd into, what sort of an intelligent Being this must be, which is able to perform so difficult a Work. Here perhaps some may affirm, that an intelligent Being inferiour to God, may be able to do this. 'Tis true, Man, as being created with a Power of acting, may be able to move himself, but what besides? 'Tis too inconsiderable to speak of. Can he by all his Art and Strength give Motion to the Planets and Comets? Can he project those huge Masses of Matter with such prodigious Velocities, as to make the Planets describe Orbs, which take them up twelve or thirty Years

Years in making one Revolution? Or, the Comets, some of which spend more than five Hundred Years before they return again? This all Mankind must allow to be impossible. These vast Bodies therefore must require some other intelligent Being to give them their Motion; and either his immediate Assistance, or some other other Cause assign'd by him, to preserve it. I fancy by this time, it will be easily conceived, that none other but God can do it.

Since therefore, the Planets and Comets received their Motion from the Hand of God, it will hardly be doubted, but that his Almighty *Fiat* still preserves their Motion. This therefore, must be one of these two ways; either from himself immediately,

ately, or from some other Cause assign'd by him. To think that God Himself should be continually giving Motion to these Bodies is unreasonable. And since that God has created secondary Causes, to keep Himself from always working Miracles ; Why should we not think, that He has created one to order and regulate these great Bodies ? And if so, what can bid fairer for it than *Gravity* ? Nay, if this be allow'd, 'tis plain, that *Gravity* is the Cause.

To sum up all. God at first, created Matter with *Gravity*, as a secondary Cause, to keep the Planets and Comets revolving in their Orbs ; and to continue and preserve that sweet Harmony, which is visible among the celestial Bodies ; and it is probable

ble will continue it so long as the Works of his Hands shall please Him ; and when he thinks fit to take it away, then all those vastly distant Planetary Systems, shall be summon'd to an universal Chaos ; and nothing but Amazement and Confusion shall be scatter'd throughout the Universe.

Thus we see how necessary a Property, *Gravity* is to Matter ; what Advantages arises from it in the material World ; and what Inconveniences would follow from its Absence. And shall we now, purely to please our selves, to shew how far we can stretch our Imaginations, deprive Matter of the most useful and necessary Property it can boast of ; and for the Sake of one new Idea, strip the

the Universe at once of all its Glory? It will be much more laudable, and not the least prejudicial to Philosophy, if we allow *Gravity* a Place among the primary Qualities of Matter; which I am sure, for its Use and Excellency, deserves the Highest.

Let us now, in the last Place, consider the Difference between Matter existing with *Gravity*, and Matter existing without *Gravity*, in respect to their primary Qualities.

I must own, after Matter has undergone so strange an Alteration, which is sufficient to rend its Constitution, and diversify its Nature; I can have no Idea of the Substance it self in general; therefore, it is impossible I should of its Properties. But to be

be as favourable as I can, since I can-not imagine, I will suppose Matter to exist without *Gravity*. This done, there is one primary Quality offers it self, but I can find no more, and that is, Immobility, or an Incapacity of Motion. For, as I have shewn before, if Matter exists with *Gravity*, Motion is a Consequence of its Action, and a Capacity of Motion, of *Gravity* it self. But if we suppose Matter to exist without *Gravity*, then the contrary must happen, viz. That Immobility, or an Incapacity of being moved, must be a necessary Consequence of such a Supposition; therefore, Immobility, or an Incapacity of Motion, must be an essential, or primary Quality of Matter without *Gravity*.

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Thus we see the Difference, between Matter existing with *Gravity*, and without ; that as Mobility is a primary Quality of Matter existing with *Gravity* ; so Immobility is a primary Quality of Matter existing without *Gravity*. What surprizing Consequences follow from such a Supposition, will appear from the following Conclusions.

First then, Can we suppose a Globe of Matter without *Gravity*, to hang pendulous in the Air, without a Capacity of descending, or ascending, or being mov'd in any other Direction ? But since they will have Motion to be preserv'd after *Gravity* is taken away, can we suppose a System of Bodies to clash and strike against one another, and cause no Effect

Effect either in their Motions or Directions? Can we suppose a Man to fall from the highest Rock or Turret, without receiving any Hurt by the Fall? Or lastly, Can we imagine a Cannon-Ball to be shot against a Man's Head, and he not to perceive it? These and such like would be the Consequences of Matter existing without *Gravity*. And if any one can imagine these Things, then he may suppose Matter to exist without *Gravity*. In short, if we can suppose the material World to be wholly depriv'd of *Gravity*; then there will be nothing in it, either effecting or effected; then we shall intirely lose all our Sensations of Heat or Cold, of Light, Sound, or Colours, since these depend on the Motion of small Particles of Matter affecting our Organs

gans of Sense ; and consequently most of our Senses would become useless unto us.

I shall only beg leave to observe one Thing further. Some may say, that all the primary Qualities of Matter offer themselves at the first View, or Idea we have of Matter, but that *Gravity* does not so. But if we could lay aside all Prejudice in our judging of the Nature of Things, we should find, that we have an Idea of Extension and Figure, sooner than of Solidity and Impenetrability ; but we should find that we have our Idea of these Properties from Experience and Observation ; We also have our Idea of *Gravity* the same Way. The Cohesion of Parts, is also essential to Matter, and it is from hence, that we

we have our Idea of Extension, for if Matter was intirely depriv'd of Cohesion, or did not at all Cohere, then we could have no Idea of Extension, for Matter being reduced into its smallest Particles (if any such there be in Matter, since it is so porous) would become a Fluid, thinner and lighter than any in Nature.

But to conclude all, We must either, as the learned Mr. Cotes says, allow *Gravity* to have a Place among the primary Qualities of Matter; Or else, we must deny that Extension, Mobility, or Impenetrability has. And the Nature of all material Things, according to their active or passive Powers, will either be rightly accounted for by their *Gravity*;

wity; or will not by their Extension, Mobility, and Impenetrability.

N. B. Perhaps I may have drawn more Consequences from the Supposition of *Gravity* not being essential to Matter, than the World may be willing to allow me; but it will be enough for me, and which answers the End and Design of this Paper, if I have advanced such Arguments, and offered such Reasons, as are in themselves sufficient to shew, that *Gravity* ought be number'd among the primary Qualities of Matter.



F I N I S.

